



AQD's mudcrab R&D

By **M Surtida**

THEN.

Studies on mudcrab, *Scylla* species, at AQD started in 1977. Researchers AF Laviña and AS Buling were successful in their first attempts at hatching mudcrab with rates varying between 75 - 90%. Two out of three trials on larval rearing yielded a few megalopa. The larvae survived salinity levels as low as 15 ppt until the 14th day of rearing. Other larvae were able to survive in salinities of 30-32 ppt for 8-13 days. Zoea molting was hastened by lowering the salinity to 25-27 ppt.

Artificial broodstock of juveniles and adult crabs has been made possible by using a simple refuge system made of compartmented hollow blocks. This system minimized fighting among crabs.

Feeding rates of juveniles and adult crab were established based on the average body weight from an experiment using mussel meat.

Hiroshi Motoh, a visiting scientist at AQD in 1977, provided the species identification belonging to the genus *Scylla* and the differences among them were pointed out. Motoh also conducted laboratory breeding of the mudcrab through zoea and megalopa stages. The zoea larvae were reared until the crab stage.

In 1979, a study was conducted to find out at what salinity levels germ cells of male and female crabs attain maturation. The study recorded gonadal condition indices to be highest at 28 ppt from February to June and at 20 to 22 ppt from July to November 1978.

In 1980 AQD published the *Field guide for the edible crustacea of the Philippines* also by Motoh. A general description of the mudcrab is given.

Dan Baliao studied the culture of mudcrab at different stocking densities in 1981. Survival, growth, feed conversion, production, and carapace size of crab were monitored. Crab stocked at 5,000 per ha had the highest average weight and percentage survival. A study conducted in 1983 again by Baliao found mudcrab culture in brackishwater ponds in combination with milkfish to be feasible. It covered the entire process of culture like site selection, source of juveniles, rearing pond operation, harvest, and yield. A computation for a one-hectare mudcrab pond based on current prices was included.

Mudcrab studies in 1988 and 1990 -- like the study of Renato Agbayani and colleagues published in *Aquaculture* 91: 223-231 -- mainly dealt with technical and economic considerations on mudcrab monoculture while two studies were conducted in 1992 on the grow-out culture in pens and floating cages set up in the Iloilo River and on stock assessment. In the first study, juveniles were stocked at densities 5, 10, and 15 per m² and were fed trash fish and formulated diet for 120 days. The best results were obtained at a stocking density of 5 per m². The second study was on the abundance of juvenile mudcrab in mangrove and non-mangrove areas in Tinagong Dagat and Sapián Bay conducted by Noel Solis. The mudcrab were caught by baited conical bamboo traps or "taon", operated during the full moon and new moon periods, set during the low tide, and harvested during the next low tide. Abundance peaked in March-April and dipped in July-August. Mudcrab in the mangrove areas ranged 2-10 cm carapace width; in non-mangrove, 3-14 cm. Smaller crab were caught from January-May; larger ones were caught in November.

NOW.

A focused and comprehensive study on mudcrab has been resumed following the sporadic and undirected studies of mudcrab in the past. The present studies being conducted pick up from where the last study left off or perhaps even fill the gaps between studies. AQD now conducts mudcrab research funded by the Australian Centre for International Agricultural Research (ACIAR). This project focuses on all phases of mudcrab culture: broodstock development, larval rearing, and pond grow-out.

Broodstock development

The key to good hatching and survival of larvae is the quality of eggs produced by the spawner. Good quality eggs are produced by female crabs that are housed in suitable facilities, provided with a nutritionally effective diet, and optimal water quality conditions. AQD researcher Oseni Millamena has developed a suitable broodstock maturation system for

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mudcrab patterned after the Australian system but using local materials.

Using this maturation system, Millamena evaluated the reproductive performance of mudcrab (mean body weight = 343-380 g) fed with different diets. Mudcrab were stocked in 3 units of 10-ton maturation tanks at 8 females per tank. Tanks were provided with sand substrate and a shelter for each female. The treatments used were natural food (T1), a combination of natural food and artificial diet (T2) and artificial diet (T3). The natural food were squid, mussel meat, and trash fish given alternately each day while the artificial diet was modified AQD-formulated diet for tiger shrimp broodstock.

Among the diets, broodstock in T2 gave the highest number of spawnings with hatching (88%); fecundity (7,855 eggs per g female BW), egg fertilization rate (88%) total number of zoea (51,625,083); and broodstock survival (65%). T1 had the lowest values of the above parameters. T3 had intermediate values but was best in larval quality measured as zoea growth index.

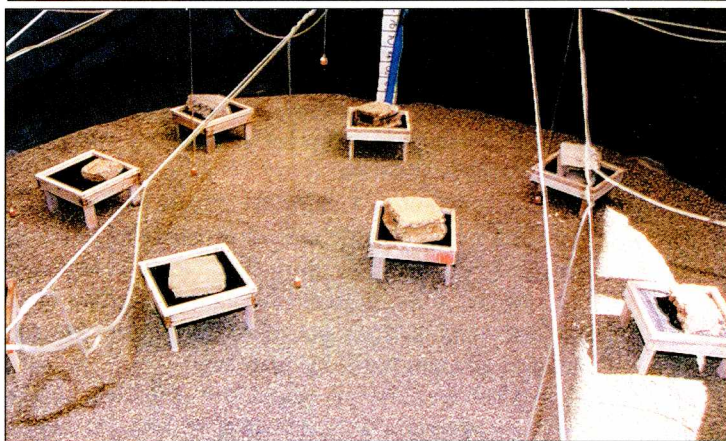
Millamena found that the combination diet gave the best reproductive performance followed by the artificial diet while natural food gave the poorest response. Although it is possible to mature and spawn mudcrab broodstock on natural food alone, use of the artificial diet alone or as a supplement promoted consistent spawning and hatching of good quality larvae.

Larval rearing

A present practice in mudcrab pond culture is to stock wild-caught juveniles. But these are now getting scarce. To have continuous seed supply, hatchery techniques must be developed. Previous studies show that production of mudcrab zoea and megalopa has been achieved but survival rates are very low and inconsistent.

Emilia Quintio, AQD researcher, compared the survival, growth, and development of the mudcrab larvae using several feeding schemes. She also determined the feasibility of rearing mudcrab larvae using larval artificial diets which have been found successful in hatchery rearing of the tiger shrimp. Quintio obtained the newly hatched zoea from the broodstock development study. Zoea were reared in 250-liter containers at 50 ind per liter and fed various amounts of AQD-formulated larval diet at 2 mg per liter per day + 0.25 mg / l / day increment per substage or 0.5 mg / l / day increment per substage in combination with natural food. Larvae fed natural food alone served as the control. The amount of artificial diet was based on

AQD's broodstock maturation system for mudcrab



the results of previous experiments on various feeding schemes. Based on one run, larvae fed artificial diet combined with natural food had better survival (9.3-10.5%) than those given all natural food (3.3%). Growth and larval development did not differ significantly. Supplementation of artificial diet could improve the survival of crab larvae and reduce dependence on natural food.

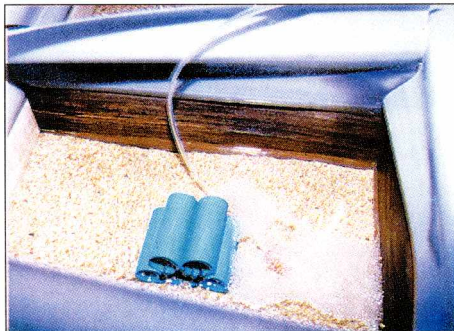
Megalopa rearing

Survival and growth of megalopa to crablet were compared in 30-liter tanks for one month using various unprocessed natural food: squid, mussel meat, trash fish, and *Artemia* biomass as control. Preliminary results showed best survival in crabs fed with squid (45.6%), followed by trash fish (41.5%), *Artemia* (31.5%), and mussel meat (28.5%).





AQD's set-up
for rearing
mudcrab
megalopa to
crablet.



At present, mass production of crab larvae in 10-ton tanks is being carried out. The megalopa produced has been successfully reared to crablets by Eduard Rodriguez. He is using hapa net in nursery ponds.

In a newly completed study using light and electron microscopy, AQD researcher Gilda Loya-Javellana found that the major ontogenetic changes in the foregut during development from zoea 1 to megalopa were in terms of timing of appearance and development of the gastric mill and gland filter, sclerotization, setation, and size of the cardiac chamber. Such changes have implications on the feeding abilities and stage-specific feeding regimes appropriate during culture.

Pond culture

Mortality during the grow-out phase has been attributed to cannibalism. It appears to be partly dependent on stocking density, says AQD researcher Avelino Triño. In other countries, shelters are provided in some ponds to protect crabs during molting and to minimize cannibalism. *Gracilaria* as shelter has been found to reduce cannibalism.

Triño compared the growth, survival, and production of monosex pond cultured mudcrab at three stocking densities (0.5, 1.5, and 3 pcs per m²) with *Gracilaria* as shelter (Table 1). It includes a comparative cost-return analysis.

The study showed the highest net income at 1.5 per m². Partial budgeting analysis revealed that net benefit (P73,635.00; US\$1 = P25) increased as stocking density was increased from 0.5 to 1.5 per m² but no net benefit accrued when stocking density was further raised to 3.0 per m².



Nursery pond and experimental pond culture set-up

Comparative cost-return analysis showed that higher profit, ROI, and lowest production cost were attained with the male monoculture. Bigger profits can be earned (P104,808) by using male crabs for monoculture rather than females although the market price offered for females is higher than for males.

IN THE FUTURE.

On 21 October 1996, AQD launched a technology verification study on mudcrab with a cooperator at EB Magalona and Himamaylan, Negros Occidental. The verification study is conducted at stocking densities of 10,000 juveniles per ha using nylon net enclosures or concrete-lined ponds in selected farm sites in the Philippines. Its objectives are to attain an average body weight of 250 g, 85% survival, and net production of 1,200 kg per ha per crop (see related article on page 16). It also aims to verify the economic viability of raising mudcrab in brackishwater ponds using net enclosures or concrete-lined ponds. To compensate for increased stocking, additional hides or shelters are provided in addition to the earthen mounds constructed. Paddle wheel aerator and water pump for regular water exchange may

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Table 1 Growth, survival, and production of male or female pond-reared mudcrab at three stocking density levels.

Sex	Male			Female		
	0.5	1.5	3.0	0.5	1.5	3.0
Stocking density (/sq m)						
Final weight (g)	475.40	428.84	408.67	327.10	331.81	325.0
Final length (cm)	8.93	8.66	8.89	8.21	8.40	8.51
Final width (cm)	13.10	12.78	13.14	12.20	12.15	11.98
Specific growth rate (SGR; %/day)	3.47	3.3	3.03	3.0	2.93	2.97
Feed conversion ratio (FCR)	2.1	3.9	6.3	2.3	4.0	6.0
Survival (%)	97.3	56.4	27.5	99.1	57.04	33.6

Values are averages. There was no interaction between sex and stocking density levels; initial size at stocking: weight, 7.3-11.0 g; length, 2.4 - 2.92 cm; width, 3.5 - 4.26 cm.

also be provided to reach the optimum water condition of the pond. Also, efficacy of nylon net enclosure as substitute to the generally accepted bamboo slats which is relatively expensive and more laborious to install shall be determined. Utilization of concrete-lined ponds earlier used for tiger shrimp as alternative culture area for mudcrab may also prove advantageous.

Following the above procedures, marketing of crabs with average body weights of 300 g and above has been on-going after 120 days of culture. Molting, undersize or any undesirable crabs for market are returned to the pond. This activity is normally done during spring tide cycles and / or when the price is right. The latter normally causes delay in marketing. About 792 kg has been recorded as an encouraging yield.

Other cooperators / pond owners have started adopting the above techniques. These are Alex Montelibano in EB Magalona (1 ha), FSD Farm in La Carlota (2 ha), and the Gargarita Farm in Himamaylan, Negros Occidental (0.5 ha). The problems identified in this verification project are availability of quality seed stock (*Scylla* sp.), scarcity of trash fish, and marketing.

Another on-going technology verification project is mudcrab production in mangrove or tidal zone using nylon net enclosures (see related article, page 21). Technology verification head Dan Baliao says that the project aims to verify the economic viability of raising mudcrab in nylon net enclosures along mangrove swamps or in tidal zones in various farm sites in Palawan and to attain production yield of 600 kg per ha per crop or more in 3 to 4 months culture period and survival rates varying from 65 to 70%.

Specifications for net enclosures and tidal flat preparation are innovations introduced in this mudcrab culture that maintains the natural environment while culture is on-going.

Projections on return on investment is 54% and payback period is 1.8 years (see listing below):

Total cost estimate per crop	₱ 116,000
Total cost estimate for two crops	232,000
Gross sales of mudcrabs (1,200 kg per ha per crop @ P 180 per kg	216,000
Gross sales of mudcrab for 2 crops per year	432,000
Net profit per crop	100,000
Net profit for 2 crops per year	200,000
Net profit after (35%) tax per crop	65,200
Net profit after tax for 2 crops per year	₱ 130,000
Return on investment (ROI)	56%
Payback period	1.78 years

A preliminary research result released by Loya-Javellana showed encouraging results. Larval rearing runs in November 1996 and February 1997 have been successful in producing 628 and 1,227 crablets. Loya-Javellana used 500-1,000 liter capacity fiberglass tanks. An average survival rate of 85% crab instars from megalopa was realized. To date, crab from these batches have attained sizes of approximately 8-13 cm carapace width. Some of these F_1 stocks have shown berried condition recently.

The problem of aggression as a major cause of mortality during culture is also being addressed by Loya-Javellana's study on shelter-related behavior in crab.

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